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By Hon. Edward Everett.
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REPORT

TO

THE NAVY DEPARTMENT,

BY

CAPTAIN DAHLGREN,

CHIEF OF THE ORDNANCE BUREAU.

REPORT

TO

THE NAVY DEPARTMENT,

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BY

CAPTAIN DAHLGREN,

CHIEF OF ORDNANCE BUREAU.

BEING

ONE OF THE DOCUMENTS FROM THE NAVY DEPARTMENT ACCOMPANYING THE ANNUAL MESSAGE OF THE PRESIDENT TO CONGRESS, DECEMBER 1, 1862.

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REPORT.

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BUREAU OF ORDNANCE, NAVY DEPARTMENT,
November 22, 1862.

SIR: The following is respectfully submitted in explanation of the present condition and probable necessities of the Ordnance of the Navy:

The existing crisis found this branch of the public defence entirely unprepared for so great an emergency. The quantities of cannon and of powder which were on hand might have been sufficient for the navy as it then was; but the large number of vessels that were added to it so rapidly rendered it very embarrassing to provide for them the requisite supplies.

It was, therefore, necessary to return to service most of the older artillery which had been superseded by newer and more powerful calibres, and to exert all possible means to procure powder for immediate consumption.

Had our Navy been on a footing commensurate with the obvious wants of the country for ordinary purposes, these difficulties and anxieties would not have been experienced.

I feel it, therefore, to be my first duty to urge that suitable provision of ordnance material be made for probable future necessities of the Navy.

Most important among them is nitre, which enters so largely into the composition of gunpowder that it may be said to be gunpowder itself, with some slight additions of sulphur and charcoal under proper combination.

It is not produced naturally in this country, nor by any other but India, except in insignificant quantities.

Hindostan alone supplies the whole world, which being a British dependency, places us entirely at the mercy or caprice of that power for our stock of this essential article.

We have already received an impressive warning of the promptness with which this supply may be cut off. For when the Trent affair occurred, the United States possessed several thousand tons of nitre just about to be shipped from England. This was detained under a general order of the government prohibiting the exportation of nitre, and remained useless to us for some months, until the British authorities chose to allow it to egress.

No argument, therefore, is needed to sustain the policy of providing against the recurrence of such a difficulty.

Wherefore, among the earliest measures which I adopted in entering the Bureau was to resort to all possible means to secure a stock of nitre, domestic and foreign, which has so far succeeded as to place our Navy beyond the danger of immediate necessities; and it is gratifying to add that there is a reasonable prospect of obtaining a large amount from our own resources.

I recommend, however, that suitable appropriations be now made so as to give this policy an authorized and more extended form, by the purchase of large quantities of nitre and the erection of proper depositories for its safe-keeping.

These items are asked for in the estimates.

The course of events has indicated the necessity of suitable interior depots for naval cannon and stores.

In the West, one or more of these should be located upon a principal water-

course, to which the United States gunboats on the Mississippi and Ohio rivers can have ready access, and receive promptly their supplies of cannon, shot, shells, and other munitions of war, which are now furnished tardily and with great difficulty from distant points.

An interior depot is also required to receive and secure the powder which is to supply the small magazines on the rivers, and to store the nitre, sulphur, and other materials that are best kept, for a long time, in their original condition.

In the East, there should be an interior depot for the same purpose. Because it is exceedingly unsafe to hold, as we now do, the entire stock of powder and other stores at our Navy yards, where they may be exposed to attack seaward, or be very troublesome to dispose of if hostile operations occur even in their vicinity.

These interior depots should have ready communication, by railroad or canal, with the exterior receptacles for immediate consumption.

The appropriations suggested in the estimate for this purpose are small, and rather intended to ascertain the wishes of Congress and give immediate shape to the measure than to fix its limit.

Of the estimates presented I can only say that they are no greater than the present wants of the country demand. Nominally they are very little greater than those of the preceding year. In reality they are just as much less as the difference that may exist between the government paper and the metallic standard

It would be, perhaps, safer to increase than diminish them.

As for the distribution among the several objects, it is very general, and unavoidably so; because it would be as impossible to define precisely what will be wanted as it is to say to what objects the funds will be applied for an entire year, beginning eight months hence.

It gives me pleasure to bear testimony to the promptness with which the private founderies have met the demands on them from the Bureau.

There is, in my opinion, no class of persons engaged in the service of the government who better earn what is paid to them.

The business is only remunerative when successful, the risk is considerable, and the closest inspection is maintained on the whole of the work.

Besides the firms who have been for a long time engaged in the business, several others have offered and received orders, so that there are now seven private establishments engaged in making cannon for the navy, viz: Knap & Rudd, Pittsburg, Pennsylvania; Alger & Co., Boston, Massachusetts; R. P. Parrott, Cold Spring, New York; J. Sparrow, Portland, Maine; Hinckley & Williams, Boston, Massachusetts; Z. Chafee, Providence, Rhode Island; Seyfert & McManus, Reading, Pennsylvania.

It is a natural consequence that the business of expending an appropriation fifteen to twenty times as great as formerly should call for a corresponding increase of officials to see that this work is faithfully executed.

The single clerk allowed by the recent law is entirely insufficient; wherefore I have asked for the number that is now needed.

An additional compensation is also asked for the clerks employed in the office of the ordnance yard; $1,000 a year for capable men who work from bell-ring to sunset is a very inadequate remuneration.

The officers attached to the ordnance yard should reside in it; which has not been usual hitherto, nor indeed possible, for want of quarters. The work goes on by night as well as by day—heavy requisitions have to be met at all hours, and there is a large amount of public property to be cared for, particularly accumulations of powder. So that the presence of the officers is indispensable; and there being no suitable quarters for them, I have inserted a very small amount for that purpose. which I hope may be allowed entirely on public considerations.

IRON-CLADS AND ORDNANCE.

The constant and very natural solicitude manifested by the public in the changes which have been and continue to be made in the construction and armament of our ships-of-war may warrant a more extended notice of technical detail than might otherwise find place in a document of this nature.

And yet no definite conclusion has been reached in regard to either of these important problems.

Indeed, the most casual observer of current events can hardly fail to perceive that neither of them has advanced beyond the first proposition.

And both are so unavoidably interwoven that it is impossible to treat or consider either independently of the other, or to form any reliable opinion as to their future course or final shape. They represent, in fact, but another phase of the competitive progress of attack and defence; impelled now, however, by existing circumstances with a rapidity beyond all precedent in naval affairs.

The old, well-known practice of firing solid shot from 32-pounders, and, occasionally, 42-pounders, at huge wooden structures, made its last appearance at the battle of Navarino, a third of a century since. This was the system in vogue during the time of Nelson, and our own Captains of 1812.

Then the defence had the advantage of the attack, for the broadsides of these vessels, when continued for hours, were seldom able to do more than destroy masts, men, and guns. The instances are very rare of a line-of-battle ship being sunk, or fatally injured in battle by the sole action of shot.

The introduction of shells changed entirely the relation of naval attack and defence.

Their use had been desultory and exceptional before the time of Paixhans; but he systematized and applied their power. So slowly, however, did the new weapon gain ground that he just lived long enough to learn of its first signal exhibition in actual conflict at Sinope, some thirty years subsequent to the complete public enunciation of his views.

It almost seemed as if naval men were reluctant to admit the consequences that were obviously to proceed from the use of shells.

The ordnance specially designed for them were only allowed in small numbers aboard of ships, and merely as auxiliaries to the guns for shot.

Our own screw frigates of the Merrimack class were the first (1854) which carried entire batteries of shell guns; and these not of the lighter description known as "Paixhans," but capable of greater range and accuracy, as well as of discharging solid shot if the emergency should arise.

The advantage of which is now apparent from the fact that our IX-inch and XI-inch guns are found to be, in a measure, available against iron plating, because they will endure solid shot fired with one-half greater, and even double, the original charges.

So that we have the leisure to consider and devise any other species of ordnance that may be better adapted to the purpose, and are not precipitated into hasty or questionable measures.

The English, French, and Russian ships having been only provided partially with shell guns, there was no illustration of the full effect of shells in any of the operations during the Crimean war, though there was quite enough at Sinope to indicate unmistakably what might be expected from the general use, against ships, of explosive projectiles of large calibre.

And this led promptly to the first practical development of the measures that the defence would be likely to adopt, in order to keep out such a destructive means of offence, and which have since so largely exercised the ingenuity and the finances of Great Britain.

At Kinburn (October, 1855) the French brought into action three vessels

that had no pretension to be termed more than floating batteries, for their power of locomotion was very inconsiderable, but they were cased with iron and had powerful guns. The Russian shot did not penetrate the plating, but a few of them entered the ports and did some mischief.

The English had prepared some vessels of a like description, but they did not arrive in season, and were therefore unable to participate in the attack on the Kinburn forts.

Peace was soon after declared between the belligerents, and very little attention seems to have been given, for two or three years, to the subject of iron-clad ships, until the French produced the first sea-going frigate of that kind—the Gloire—which was followed by a sensation and action in England highly appreciative of the possible consequences of being slow in acting on the hint.

Of course there was a variety of opinion expressed by public writers as to the capacity of this formidable craft, most of whom inclined to a depreciation of her invulnerability and sea-going qualities.

The British government very wisely, however, decided not to lose time in constructing similar vessels, and has since followed the decision with a remarkable celerity, quite regardless of expenditure.

On the 25th of February, 1859, the First Lord of the Admiralty (Pakington) announced to Parliament the policy of the government in this respect; and the construction was begun of an iron-clad frigate that was to surpass the "Gloire."

This ship has been completed, and is well known as the "Warrior;" others soon followed in France and England, and armored ships are, by common consent, for the time at least, to constitute the main force of all Navies.

Of course there is every variety of opinion expressed as to the proper material and construction of such vessels; and the British government, not feeling at liberty to wait until results have decided, are compelled to make use of whatever may seem most plausible for the while; and thus we are astonished by the most gigantic and costly experiments that the world has ever seen.

For it so happens that circumstances impose on England and France the necessity of grappling with the most difficult solution of the problem, their shores being washed by the deep waters of the ocean; therefore their iron-clads must be more than mere floating batteries, and be possessed of the best nautical qualities.

With the United States the case is, happily, different—the depth of water on the coast being generally adapted to vessels of light or moderate draught, and only a few of our ports are at all accessible to heavy iron-clads like those of France or England.

The solution of the question is, therefore, in its immediate requirements, comparatively easy and inexpensive for us.

Vessels of the "Monitor" and "Ironsides" class are likely to serve present purposes sufficiently well, and to give time to obtain from our own and the experience of others better data than can now be had for advancing to a more perfect order of vessels.

Notwithstanding the earnest and long-continued course of investigation which has been carried on by the governments interested, so little is yet positively known of the effect of Ordnance and the resistance of iron plates in different forms, that the ablest and most experienced cannot agree in regard to the armor best calculated to oppose the most effectual resistance, or upon the cannon that shall be employed to overcome that resistance.

In both cases there are conditions which impose limits to the weight of gun and of the plating.

At the very outset the latter presents itself, and the ship-builder finds himself compelled to changes of the most radical nature, in order that the ship may carry the ponderous armor intended for it, and which in some cases amounts to 1,000 tons.

Some of the dimensions have to be reduced so that a vessel with one-half greater capacity than a two or three-decker is so far shorn in height as to leave but one gun-deck, thus becoming a frigate by the general definition. Of course the ordnance is reduced proportionally in number and weight.

But there is a check even to this reduction of dimensions, and the thickness of iron must not exceed a certain extent. At this date common practice does not go beyond $4\frac{1}{2}$ to 5 inches.

When this difficulty has been disposed of, the *mode* of armoring next demands attention. Shall it be a solid plate, or made of many plates of less thickness? But, most troublesome of all, how fasten it securely to the side? For this is proved to be the weakest point of the defence, and no remedy has yet been devised to prevent the fracture of bolts and nuts, even though the integrity of the plate is not materially injured.

If, to avoid this, recourse be had to a structure entirely of iron, it appears, from present data, that the resistance is too much reduced thereby. It is preferred, therefore, to adhere to armor backed by the wooden fabric.

In the wake of these almost insolvable questions follow others which, though not essential at first, become so eventually by time and service, such as the probability that the incidents of sea service will weaken the connexions of the armor with its own parts and with the ship, and that the difficulty of caulking will allow of more leakage than is convenient.

The ordnance expert can by no means rejoice in being free from difficulties that puzzle his ingenuity.

The number of cannon being reduced to a third of the number he is accustomed to rely upon, how shall he supply the loss of force by the weight and kind of those which remain?

If he acquires power by greater weight, he loses by loss of time in manipulation of gun and projectile, hence some reduction by slowness of repetition. Then, again, shall he use rifled or smooth-bore, breech or muzzle loaders? Shall he pierce or crush and break bolts and strip off the armor, or shall he even attempt to enter the interior with shells?

How economize the open space of the ports when the gun is out, or close it when in?

The steam engineer has also his demands, for great speed is indispensable, and he thus adds another trouble to those of the already bewildered shipwright.

Leaving these queries to be answered by the parties most concerned, it will suffice here to say that, just now, the offence has decidedly the advantage, and no sea-going ship is considered to be so armored as to be impregnable to artillery.

Of the French results and inferences touching the several points we know nothing beyond what is necessarily disclosed to the observer in the construction of ships.

The British government have practiced less reticence; and if we are not permitted to become acquainted with the reasoning of their officials, the results from which they do reason are so far public that one cannot err very widely as to their general bearing.

A large number of witnesses have usually been present at the trials, including officers, engineers, ship-builders, and others, civil and official. The press is also well represented, and in a few days afterwards all the proceedings are detailed minutely to the public, discussed in Parliament, and in meetings where the ablest professional men are assembled for the purpose.

So far as an opinion can be formed from such sources, one is led to conclude that those who, from their distinguished abilities and opportunities of investigation, should be best qualified to judge, have arrived at no final decision in regard to any of the essential points of the problem above stated, which is, indeed, reasonable, when it is noticed to what extent these differ, and even conflict.

About a year since (October 21, 1861) a number of eminent dignitaries, mili-

tary, naval, and civil, met, in order to witness the trial of a target representing the "Warrior's" sides. It was supposed that all the power which ordnance could exert for such a purpose was brought into play; and after this had been done it seemed as if the witnesses were generally favorably impressed with the endurance of the target, and therefore of the "Warrior."

But not long after (April 8, 1862) Sir William Armstrong placed in front of this, or a similar target, a gun which he had just completed; it threw a round shot of 156 pounds, which, with 50 pounds of powder, most unexpectedly changed the whole aspect of the question by its treatment of the target, which was said to have been completely pierced.

The revulsion in common opinion went so far as to discredit the "Warrior" entirely, and the fallibility of that vessel was pronounced certain.

But during a discussion in Parliament a member maintained that the facts had not been accurately stated even by official authority, and the deductions were consequently more unfavorable to the target than was correct. He even affirmed that the target had not been fatally injured, but would in fact have kept out the shot from entering a vessel.

Whether for this reason or not, the trial was repeated, and very fully disposed of all doubts in favor of the target; but it settled the gun also, which burst at the fourth round.

Thus demonstrating that if the target were penetrable by the fire of such a piece of ordnance, it was only by an effort that destroyed the gun also—a risk not to be thought of on shipboard.

And hence it was inferred that the "Warrior" was impregnable to the effort of any ordnance that could be then used safely against her.

The triumph of the defence was, however, of short duration; for the rupture of the Armstrong gun left the way open to other competitors, and a long-neglected piece that had lain remote from view for several years was suggested as deserving of an opportunity to try its powers.

This was the Horsfall 13-inch, of wrought iron. Its first blow, with a shot of 280 pounds, was decisive. The plate was pierced and badly injured, while the endurance of the gun was untouched.

As if to complete the entire failure of the defence and to puzzle its advocates, Mr. Whitworth undertook to drive a shell through a stout iron-plated target, which he accomplished.

So that the system of armor that had been relied on was proven to be vulnerable by shells, as well as by shot, which was an unhoped-for advantage on the side of the attack.

Here it will probably rest for the while, until the defence shall be able to devise some plan of greater efficacy.

It would be unwise, however, to rush to the conclusion that armor is needless, because the most powerful ordnance should, under skilful guidance, be able to pierce it.

For, even against such cannon, a ship may delay the final disaster long enough to make its own guns of avail; and when opposed to any but these heaviest pieces, will still be in effect impregnable.

The case of the "Monitor" and "Merrimack" affords an illustration.

No one supposes that either of these vessels could have escaped serious injury if subjected to a course of target firing from the most recent and powerful descriptions of ordnance, yet they sustained for four hours the utmost effort of each other's batteries.

The "Monitor" was hardly more than scarred by the fire of the very guns which, on the preceding day, had in a fourth of the time acted most destructively on the hulls and crews of two fine wooden frigates.

A very high official authority (Duke of Somerset, First Lord of the Admiralty, House of Lords, April 3, 1862,) has, to be sure, imputed the default of injury to

life or limb in this combat to a lack of power in the artillery which the two vessels carried; which is no doubt true; but it is equally true that no guns of like weight and kind now used in the British Navy would have effected as much under like circumstances.

These cannon are not "idle against iron plates," as may be shown by their operations upon samples of Warrior targets on which they have been tried here. Nor are they "rifled shell ordnance." Nor is their initial velocity as low as 900 feet, as stated by the Duke.

The XI-inch guns of the "Monitor" were designed chiefly for shells, which were computed to leave with a velocity of at least 1,250 to 1,300 feet. In the action shot were used with an initial velocity of about 1,120 feet.

But since that time the same class of gun has been ascertained to be capable of throwing solid shot of 169 pounds, with a charge of 30 pounds, giving an initial velocity of 1,400 feet.

The IX-inch guns of the "Merrimack" were intended principally for a shell of 72 pounds and a charge of 10 pounds; and therefore gave an initial velocity of about 1,400 feet. But they can be safely used with a solid shot and 13½ pounds of powder, which produces an initial velocity of 1,290 feet.

One of these guns was fired 750 times with its shell, and then 500 times with shot and the high charge, showing no symptom of giving way after such severe usage.

The Duke of Somerset more nearly approached the present state of the question when he doubted the capacity of plates finally to resist the action of Ordnance; but was in fault in overestimating the service to be expected of the Armstrong gun.

With regard to the results spoken of as obtained in England, which assign a superiority to the solid plates, it may or may not be that Captain Ericsson selected, or was compelled to use, one-inch plates in making up his total thickness, for at that time there was very little choice in the matter; but it is certain that the practice made here proves that several plates made into one are preferable on many accounts to one solid plate, and would be so altogether if it were not for the increased number of bolts that become requisite, and are the weakness of all such plating.

Indeed, even with this disadvantage, it remains to be seen whether, by any process, a very thick solid plate can be made equal in its texture to the thinner plates.

For in every instance where I have seen a solid plate pierced by a shot the imperfection at the welds has been made manifest by their separation, although externally none such could be perceived.

In this connexion it may also be observed that for want of information it is not possible for us to form a trustworthy opinion, from the incidents of the combat, of the relative powers, offensive and defensive, of the two vessels.

We know the armament of the Monitor, and also that she was not in any way crippled by the fire of the "Merrimack"; the most telling blow was on the pilot-house, but this did not affect the immediate efficiency of the vessel.

On the other hand, we do not know to what extent the Merrimack was injured by the fire of the Monitor, nor, with any certainty, what guns she carried.

Among those recovered with the Norfolk navy yard was a IX-inch, which, by the mutilation of sight masses, trunnions, &c., must have been one of those which our men attempted to destroy on evacuating the yard in April, 1861. Its muzzle being broken off induces the belief that it was also one of the guns of the Merrimack, which, in the official report of her proceedings on the 8th of March, is stated to have had the chase shot off.

The end of an elongated shell was also found in the plates of the Monitor, showing that such projectiles were fired by the Merrimack.

These facts seem to confirm a current rumor that this vessel had IX-inch guns

on the sides and rifled guns at each end, probably 32-pounders, as we find pieces of this description used very commonly by the Confederates, or else one of the Blakely pattern, a few of which are also known to have been furnished to them.

If this be true, then the metal was entirely too light to affect the Monitor, and will account, in a measure, for the little damage she sustained.

As so much interest was at the time attracted to the material of the shot used by the Monitor, and it was averred by high authority that if she had not been restricted to those of cast-iron, but had been allowed to fire the wrought-iron shot put on board for the purpose, the Merrimack would have been sunk, I am induced to say a few words in order to correct any erroneous impression that may still exist on the subject.

The cast-iron shot fired by the Monitor average about 169 pounds, and, being used with 15 pounds of powder, had an initial velocity of about 1,120 feet.

After the action I caused ten of the Monitor's wrought-iron shot to be weighed; they were found to be 186 to 187 pounds; therefore, (with a charge of 15 pounds,) their initial velocity would have been about 1,050 feet.

So that, by using the wrought-iron shot, the projectile velocity would have been reduced; and though in no great degree, yet to that extent, whatever it was, would have increased the very cause of insufficient power, if, as generally conceded, the effect of shock be proportional to the $V^2 \times W$.

Secondly, if the criticism were intended rather for the inferior tenacity of the cast-iron, which was therefore assumed to lessen the effect of the cast-iron shot when compared with those of wrought-iron, then it is only to be said that the theory is directly at variance with the facts as exhibited in the practice executed under my immediate direction, and witnessed by yourself and many others.

The cast-iron shot does break and the wrought-iron is only crushed; but while the latter lodges in the 4½-inch plate, the former (both being of 11 inches) passes completely through the plate and nearly through the wooden backing of 20 inches, making a larger hole and badly cracking the plate.

The proper mode of increasing the power of the Monitor's guns was to have increased the charge, which the gun was capable of enduring safely, to the extent of 30 pounds; but this was not known at the time, and all will admit that the occasion was not one when any risk was to be incurred unnecessarily.

The Monitor only fired 42 shots, and of these many, no doubt, failed to strike from the unavoidable difficulty of aiming with perfect precision.

Setting aside the disadvantage due to a first essay in a combat of this kind, the circumstances were entirely favorable to exhibiting the full powers of iron-clad ships like the Monitor and Merrimack—the distances being short and the object but little above or below the level.

When much elevation is required, particularly on account of the height of the object, the fire of any ship-of-war loses proportionally in effect, by reason of the difficulty in aiming, and the vessel is also more exposed to serious damage. In the close ports of an iron-clad the former must be seriously aggravated, of which we had an example in the attack upon the work on the James river, when the "Galena" and "Monitor" participated, and could never make their guns tell fully as they would have done had the batteries been lower.

The operations that have been conducted here with reference to the power of different cannon and projectiles, as well as the resistance of iron plating, have been so far satisfactory that the results derived have been consistent. Still they are liable to such qualification as may be properly due to practice upon targets only, and in some sense favor the defence, because many sources of weakness which are unavoidable in the extensive structure of a ship are undisclosed in the strong, new, and well-knit target, but will appear when vessels are subjected to fire and to the wear and tear of time and service, especially at sea.

So long as the ponderous armor is merely attached to the ship and is not made to contribute to the strength of the fabric, but severely taxes that strength,

so long will there be involved a serious element of deterioration which will after a while impair the general capacity for endurance, and in the end unfit the ship for battle.

In this respect, as in many others, the turret class are to be excepted from much of the preceding remarks, and are probably of greater and more certain endurance under severe fire than the ordinary plated vessel. So far they are likely to find the most fitting sphere for their peculiar powers in the less troubled waters of harbors and rivers; though the ability that has devised them may also be able to give a wider scope to their usefulness.

ARMAMENT OF IRON-CLADS.

So little having been determined with regard to the preferable mode of armoring ships, there will necessarily exist, as already observed, much difference of opinion and practice as to the Ordnance that will be most serviceable. This would be reduced to very narrow limits were it possible to decide intelligently upon the claims of smooth and rifled cannon. But the obviously unperfected condition of the latter interposes an obstacle to a fair consideration of its merits, which the ingenuity of very clever men has long been exerted upon without complete success.

1. The rifled shot, when moving correctly, is the more accurate to first graze, though not materially so at moderate distances—say 1,300 to 1,500 yards. Beyond a mile its advantage in this respect is very marked.

2. But, after encountering any object, its deflections are of the most erratic description, and it generally tumbles over so as to nullify its force and render its subsequent direction beyond conjecture. Wherefore the rifled shot has no capacity for ricochet, which is one of the most certain modes of operating with the round projectiles in naval warfare, and is of the utmost importance, because so many shot fall short and strike the water first.

3. The rifle shot has greater penetration than the round, but much less concussive power.

At the present time considerable improvements are required to give regularity and certainty to the distinctive qualities of the rifled shot; and there is no little trouble experienced also with the stripping of soft metal from them, and the imperfect operation of their fuses. These being defects rather of detail, will, no doubt, be ultimately got rid of. Meanwhile, the rifle gun is gradually making its way into the service and becoming better understood by soldiers and sailors.

A glance at the forms which this arm has assumed in different countries shows the great variety of solutions that the problem is capable of, and may possibly indicate some difficulty in uniting all the qualities desired in one piece. The greatest diversity will be noticed, for instance, between the device of Armstrong and of Whitworth, and the Canon Rayé of the French. They differ totally in the material and construction of the cannon, projectile, and fuse. And while no one service is entirely satisfied with its own arm, it seems to find nothing better in that of another.

If, in battering an iron-clad, penetration only shall be the paramount consideration, and other effects merely incidental, the rifle cannon must be selected. But if the concussion and shattering of the plate and its backing be preferred, with such penetration as might be consequent thereon, then the heavy, swift, round projectile will supply the blow best adapted to such work.

So long as the present mode of plating continues, there can be little doubt that it will be most effectively attacked by cracking and bending the iron, starting the bolts, stripping off the armor, and breaking away large portions of the wooden structure within.

And to this mode of action I feel more inclined, after witnessing its effects upon a number of targets plated with solid iron, or with thin plates bolted into one, the direction of the fire being perpendicular or oblique.

The iron-clad "Galena" suffered most in this way.

The fire was so well directed (distance 600 yards) that most of the shot were clustered about the middle of the side exposed, as if the funnel had served for a mark; several remained where they had lodged in the iron plating, which, by measurement, proved to be 64-pounders; others had only dinted the armor and fallen off, while a few had passed entirely through.

Seen from the outside, the damage did not appear considerable, but within it was evidently irreparable, for the entire structure of the vessel was so shattered that there was little power of resistance left.

The number of guns being very much reduced, of necessity, in iron-clads, particularly in the turrets, which will only accommodate a pair of them, it would naturally be supposed that the weight of broadside would also be limited.

But the very large calibres that are likely to be adopted will so far compensate for the loss in number that the dimunition of power will not be important and, in some instances, there will be a gain in weight of projectile.

Thus, the Merrimack originally threw 1,424 pounds from the broadside, and the recent changes have increased this to 2,440 pounds.

Whereas the "Roanoke," which belonged to that class, and is now converted into a turret ship, will throw 2,700 pounds at an object abeam, when fully armed, and 900 pounds ahead or astern.

There must be, however, a material reduction in the celerity of fire with guns and projectiles so large as the XV-inch, whatever may be the mechanical appliances which may be brought to assist.

An XI-inch gun, with a well-disciplined crew, can be fired once a minute; but there must be much improvement in any mode now suggested before a XV-inch gun can be fired once in thrice that time.

As a certain capacity for repetition is essential to the general power of a battery, there is thus involved a disadvantage which can only be compensated to any extent by the great concentration of effect in the individual projectiles. For it may be conceived that the effects of shells of 330 pounds, and shot of 450 pounds, will be damaging beyond any experience in former battles. What may be the power of such ordnance against iron-cased ships—comparative or absolute—remains to be ascertained. This, as well as the piece itself, is yet but an experiment.

It seems superfluous to add that the IX-inch and XI-inch guns of the United States navy were intended to be used against just such ships as were then constructed; and, *for that purpose*, I may say that they combine the elements of ordnance power to a greater degree than any other guns of like nature and weight.

The use of armor for ships had then hardly received any serious consideration. Now, that it is being rapidly applied to all vessels-of-war that can receive it, the guns that have been used will give place to others more particularly adapted to such service, and the prosecution of this question occupies all the attention that may be spared from the pressing demands of the present war.

Two new classes of guns are already in existence; one of these, the XV-inch, is actually mounted on our iron-clads. The other has already been tried at iron plates of $5\frac{1}{4}$ inches thickness, with an oak backing of 18 inches, placed at 200 yards; through which its shot passed with ease. Meanwhile, the guns already on hand will be accommodated as far as possible to the new state of things, and it is satisfactory to know that a severe test proves the IX-inch and XI-inch able to bear continued firing with solid shot and charges much greater than those for which they were intended; the IX-inch one-half greater, the XI-inch double the original quantity of powder.

In this connexion it may be observed that erroneous impressions have obtained currency in regard to the mode of action which was proposed for this style of gun, an instance of which has already been noticed as emanating from

an official personage. A recent repetition of this error by a high popular authority would induce the unprofessional reader to suppose that the sole object of these guns was to fire large masses of metal with low velocity, regardless of all proper effect. Whereas it was merely designed to drive the heaviest projectiles that could be conveniently manipulated with no more velocity than would just pass entirely through a ship's side. The complete penetration of the object was to be effected, but with no more velocity than absolutely indispensable for that object; and thus the greatest amount of concussive power was combined with sufficient penetration.

These views were fully given at length in a publication made some six years since,* and illustrated by instances of practical results.

It was not to be expected that ordnance designed so particularly for a given effect upon wooden structures should be equally fitted to operate upon armored vessels. Their application to this service was, therefore, temporary; and yet, even under such disadvantages, the XI-inch shot, fired with 30 pounds, is known to act severely on targets plated with 4½-inch iron, and to have an endurance with these excessive charges that could not have been expected.

The cannon used in England to fire at the "Warrior target," in April, 1862, was made of wrought iron, after the design of Sir William Armstrong. It is said to have weighed nearly 27,000 pounds, and on the above occasion was fired four times with 50 pounds of powder and a round shot of 156 pounds.

The XI-inch gun weighs 16,000 pounds, (cast iron,) and in proportion to its weight would be doing the same work as this Armstrong gun if it was fired with 31 pounds of powder and a 93-pound shot.

One of this class, now here, has been fired 155 times, as follows:

22 rounds with 20 pounds 101 rounds with 25 pounds 32 rounds with 30 pounds	}	Shot of 165 to 169 pounds.

A charge of 30 pounds is very nearly proportional to that used in the Armstrong 156-pounder, and the shot is 80 per cent. heavier than it should be relatively, and 13 pounds absolutely than the shot of the British gun.

The gun is not burst, nor does it exhibit any indication of giving way. The Armstrong gun has burst, and it gave way with a charge of 50 pounds. It is said to have been fired 160 or 170 times, several of which were with much heavier charges—60 to 90 pounds—but of this we have no information here beyond what may have appeared at different times in the public prints.

On another occasion an XI-inch gun was fired 500 times, of which 170 fires per day were made in two successive days, which so heated the gun that it was found to be warm 18 hours afterwards. No sign of weakness was detected.

The IX-inch class, in the ratio of the British gun, should throw shot of 54 pounds, with 18 pounds of powder.

Mention has already been made of one recently proved with 750 service charges (10 pounds) and shells of 72 pounds, and 500 extra charges (13½ pounds of powder) and shot of 90 pounds, which last may be assumed to produce a strain equal to the proportional charge. The gun still looks sound.

Another of the same class, after 1,500 service charges, (10 pounds,) and shells of 72 pounds, was fired with gradually increasing charges until at the last round (twenty-second) it burst with a charge of 20 pounds of powder and 10 shot, weighing in the aggregate 900 pounds.

The endurance, therefore, of these cast-iron guns bears comparison with the best forged British guns of the latest design, and the model must therefore be good.

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* Shells and Shell-guns. Trübner: London, 1856.

The calibre of the piece, and the velocity with which the ball shall move, are entirely adaptable to what may be required.

It may be that the ratio of velocity to weight should be greater when iron, and not wood, is to be struck, which will be determined quite in season.

COAST DEFENCES.

The ease and impunity with which even one iron-clad can enter a port not specially prepared for such a visitor, and commit mischief at pleasure, suggest the policy of providing by timely measures against the possibility of damage to the immense resources thus exposed.

Some ten years since I took occasion, upon a call from the War Department,* to point to the defenceless condition of many of our harbors, particularly that of New York, which, by its facility of access and great accommodation of means, invited attack from the enterprise or cupidity of an enemy.

These means are not limited to the abundant wealth that commerce has collected from every quarter. But in the city and its vicinity are the vast workshops from which issue the ships and their engines that have within a twelvemonth given a new fleet to the country; being, in fact, so many navy yards, called into existence almost at the instant, which would lie under the very cannon of a hostile iron-clad, and, if destroyed, would deprive the country of resources not to be replaced for years.

The present state of our public affairs seems to offer good reason for considering this subject seriously and promptly. We have had, not long since, bitter experience of the facility with which the usual mode of settling a debatable question might be set aside, and an ultimatum at the outset dictated to us, with such preparation as left no doubt that our non-compliance would be visited with the same pacific correctives which history records as having been administered at Copenhagen, (1807,) at Constantinople, (1807,) and to Spain, (1804;) on which occasions the fleets of Denmark and the treasure ships of Spain were seized, and like attempts made on the navy of Turkey, although these powers were actually at peace, and were only suspected of hostile intent.

No injury can result to the public interest from speaking openly on the condition of our ports and coasts; for it is quite as well understood by others as by ourselves, these harbors being habitually frequented by foreign traders, and the amplest information in regard to them minutely shown in our own beautiful Coast Survey charts to all who may choose to examine them.

It behooves us, therefore, in good season, to estimate the danger rightly, and the remedy.

In regard to the latter there will naturally be some difference of opinion, which will be best investigated and judged of by those who shall be intrusted with the duty.

Still, taking our own great seaport as an example, my own views are that a trustworthy and thorough defence can only be made by a harmonious and just combination of forts, iron-clads, and rams, with such other minor auxiliaries as may be contributed to the general purpose; singly, neither would be effectual.

1. The principal defences of the city of New York by land are to be at Sandy Hook, the Narrows, and upon all the little islands near the city.

Whatever may be selected as the material of the interior structure of the fort, the exterior must be of iron. Lines of earthworks will also be useful in assisting and completing the position of the main work.

But by no means should bare masonry be exposed to the action of rifle cannon.

2. The sites of these works should be at a reasonable height above the water,

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* Ex. Doc. No. 5, 32d Congress, 1st session.

because the fire of ships always loses much of its effect against elevated objects; and iron-clads have still greater difficulties to contend with from the very limited degree of elevation which their ports permit, and the obstacles that interpose in aiming deliberately.

For these reasons the forts at the Narrows are illy calculated to hinder the passage of an iron-clad, or even to withstand its direct attack; less so, indeed, than the seemingly insignificant earthworks on the elevated plateau to the left.

3. A sufficient number of iron-clads should be ready to assist the forts, and to fill in the gaps left between them.

4. With these should act the most powerful rams that can be built.

Their construction to be very powerful, their lines very fine, draught moderate, filled with steam power, and impervious to shot.

This description of steamer ought never to act singly, for by a skilful and timely change in direction the vessel attacked might elude the blow and leave no good opportunity to renew it for some time; a second or a third ram, co-operating with the first, would make it impossible to avoid a direct blow from one of them.

It is obvious also that rams would be of little force in chase, unless their speed were very much greater than that of the other vessel.

Obstructions of various kinds may also be placed at different parts of the channel.

It will be seen that I now have in view only the main passage to the city, the Raritan bay and the "Kills" being easily defensible.

The same remarks which apply to New York are also applicable to many other seaports, such as Newport, Portland, &c.

And on the Pacific side, most especially to San Francisco, which, though remote from the scene of the present struggle, is yet worth all attention and care in fortifying it against attack, for this superb harbor should not be exposed to the least mischance.

The greatly increased importance of Key West, and similar islands, demands improvements in their fortifications, with a sufficient number of iron-clads and rams.

GUNNERY-SHIP.

It seems very late now to urge the institution of a system of instruction in gunnery for our seamen. Other naval powers have considered this one of the indispensable requisites for a Navy, while with us it has received no countenance whatever. In 1857, at my urgent solicitation, the Department allowed me the use of a ship for this purpose; but no measures were taken to supply men for instruction, so that the main purpose was defeated, and after a while the vessel itself was directed to another use, at a time when 200 or 300 good captains of guns could have been supplied from it yearly to the navy.

I have been entirely at a loss to conceive why an interest so vital should have been thus neglected; for whatever may be the skill of the officers, it is manifest that the effect of each gun in action depends on the seaman who adjusts the sights, takes the aim, and fires the piece. Yet this person is left entirely to his own instincts to pick up such notions as chance may throw in his way.

It seems to be a common impression that all seamen are conversant with the use of artillery, which is by no means correct. On the contrary, this knowledge is the peculiar acquirement of the man-o'-war's-men, and is only obtained in the Navy.

When, therefore, the department is, by the exigencies of circumstances, compelled suddenly to increase the number of its seamen, resort is frequently necessary to those whose service may not have been in the Navy.

The material is excellent, but still has to be initiated into the very rudiments of gunnery.

The ship-of-war about going into service, and which may be in action but a few days after receiving a new crew, is not by any means the place of schooling the recruits; yet such must be the case under present arrangements.

And this is now of even more importance, from the fact that our ships are very short of officers.

I may mention here one fact corroborative of the foregoing.

Just after the disaster at Bull's Run, (1861,) I was called on (as Commandant of the Navy Yard) to place a detachment of seamen at an important point, to assist in the defence of the lines. Three hundred prime, able-bodied seamen were mustered for the purpose, and on a preliminary examination, with a view to stationing the men at the guns they were to man, it was found that only ten or fifteen had ever served at a gun before.

Wherefore I respectfully urge that some course of instruction in gunnery may be instituted as a part of the system of the navy, *for battle is but the harvest of preparation.*

In conclusion, I beg leave to ask your consideration of the present organization of this Bureau. The nature of its duties are military as well as civil, and the minutest details of a cannon or its management on shipboard are subjects of its cognizance, as well as the directions for making cannon and all their complicated appliances.

It is thus necessarily in the closest professional contact with commanders of fleets and of ships, as well as of founders and mechanics.

I have the honor to be, very respectfully, your obedient servant,

JOHN A. DAHLGREN,
Chief of Bureau of Ordnance.

Hon. GIDEON WELLES,
Secretary of the Navy.